Remarks

The present invention is directed to a method for reducing the particulate matter emissions produced during the combustion of diesel fuel in a diesel engine to a level below the particulate matter emissions produced during the combustion of Swedish Class I Diesel Fuel in a diesel engine, the method comprising using as the fuel an emulsion of a hydrocarbon fuel and water containing a non-ionic surfactant or mixture of non-ionic surfactant, wherein the hydrocarbon fuel is a Fischer-Tropsch (FT) derived hydrocarbon, or a mixture of a FT hydrocarbon fuel and a conventional fuel, the fuel emulsion having hydrocarbon particles substantially uniform in size in the range of about 0.1 to about 1.0 microns, said emulsion being a hydrocarbon-in-water emulsion.

The Examiner rejected claims 1 and 9 and their dependents under 35 USC §112 second paragraph as being indefinite because "to practice the claim requires knowledge of something that is not of applicants' invention, it not being clear how one skilled in the art would know at what point the improved reduction has occurred". Further, the Examiner argued that it is not clear how the Swedish fuel would react under the conditions set forth in the present claims.

Applicants respectfully traverse this rejection.

Claims 1 and 9 have been amended to make it clear that the particulate matter emissions are not just reduced in some unspecified fashion but that the reduction is to a level lower compared to the level of particulate matter emissions that are obtained when Swedish Class I Diesel Fuel is combusted in an engine under the same conditions as those used to combust the hydrocarbon-in-water emulsion fuel.

This reduction in particulate matter emissions to a level lower than that obtained by the combustion of Swedish Class I diesel does not require that the practitioner actually has to combust Swedish Class I diesel in an engine to establish a base line, then

combust the hydrocarbon-in-water emulsion to determine the level of improvement in particulate matter emissions.

The teaching of the present text already does that!

Reference to Figures 2 and 3 already demonstrate that the particulate matter emissions of the emulsion fuel are about 53% lower than the base line which corresponds to the Swedish Class I Diesel taken as the best standard. The base line, set at zero % change, represents to the comparable emissions levels generated by the combustion of Swedish Class I diesel at comparable conditions.

As is seen, in Figure 2, at low load, the combustion of the emulsion fuel (hydrocarbon particulate size of an average 0.7 microns with 95% smaller than 1 micron in size) generates about 53% lower PM emissions while Figure 3 shows that at medium load the emulsion fuel generates about 91.5% lower PM emissions as compared to Swedish Class I diesel.

Thus, the language in the claims is not an invitation to the practitioner to conduct some undefined experiment but rather is a reference to the teachings and comparisons already presented in the present application.

The present invention clearly teaches that the improvement in PM emission reduction compared to Swedish Class I Diesel is secured when the fuel combusted is a hydrocarbon-in-oil emulsion heavy hydrocarbon particle substantially uniform in size and between 0.1 to 1.0 microns in size, i.e., predominantly small particles which are predominantly 10 microns or less in size.

There is no "point at which the improved reduction" occurred because, as indicated in the amended claim, the emissions generated by the combustion of the hydrocarbon-in-water emulsion fuel having hydrocarbon particles of substantially

uniform size in the range of about 0.1 to 1.0 microns are always lower than the particulate matter emissions generated by Swedish Class I Diesel combusted under the same condition.

The term added to claims 1 and 9 "combusted under the same condition in an engine" finds support in the text in the teaching of Example 2 and Figures 2 and 3. The only way the comparisons can be made are when the combustions of the fuels are under the same conditions. This is inherent in running emissions comparisons and this protocol is known to those skilled in the art.

The Examiner rejects claims 1, 5-10 and 12 under 35 USC §103(a) as obvious over WO 99/63025. The Examiner argues that WO teaches a hydrocarbon-in-water emulsion comprising diesel fuel or FT derived fuel, water, alcohol and surfactant. The hydrocarbon droplets are less than 10 microns in size and the fuel emulsion reduces nitrogen oxides and particulate matter emissions.

The Examiner acknowledges that WO fails to teach how the fuel compares to Swedish Class I Diesel and also fails to teach the claimed particle size of 0.1 to 1.0 microns but that because WO teaches that the droplets are about 10 microns or less this suggests droplet sizes of 0.1 to 1.0 microns and argues that it would have been obvious at the time the invention was made to optimize the particle size through routine experimentation.

Applicants respectfully traverse this rejection.

WO does not merely recite that the particle size is 10 microns or less but rather that it makes use of a MACRO emulsion having particles of 10 microns or less.

Macro emulsions are different than the emulsions used in the present invention having substantially uniform particles in size of 0.1 to 1.0 microns. Such an emulsion as used in the present invention is a micro emulsion.

All the data generated in WO is based on the use of an emulsion having particles of 10 microns or less. Nothing in WO teaches, suggests, implies, or provides any motivation to use or test emulsions having particles substantially uniform in size of 0.1 to 1.0 microns to achieve lower particulate matter emissions compared to Swedish Class I Diesel.

In the Example at page 23 of WO, various fuels are compared. Fuels corresponding to EPA Emissions Certification Diesel fuel, CARB Diesel, RME (Rapeseed methyl ester) diesel, and Fischer-Tropsch diesel are utilized as are macro emulsions of these fuels in water. The emulsions are compared to the unemulsified fuels but specific results for each fuel/fuel emulsion pair are not individually reported. Rather, only general, non-specifically identified/attributed ranges are reported. In all cases, however, and even assuming that the lowest PM emissions results in each comparison correspond to the results from the best fuels tested, the improvement ranges from about 6% to about 44% presuming in each case that the best fuels corresponds to an FT fuel and an FT fuel-in-water emulsion. This presumption is not arbitrary but rather is based on the teaching in the present application that (1) Swedish Class I Diesel is a standard low emissions reference diesel that produces about 40-50% lower PM emission than conventional diesel and (2) FT diesel has been shown to similarly produce 40-60% less PM emissions than conventional diesel. Thus, Swedish Class I Diesel and unemulsified FT diesel can be judged to be substantially equivalent in PM emissions.

Based on this it is fair and legitimate to presume that insofar as FT diesel and macro emulsions of FT diesel constitute one of the four fuel pairs reported that the

lowest PM emission level reported in each column correspond to the emission of the FT and macro emulsified FT fuel. As previously indicated, the reduction in PM emissions obtained in WO, based on the presumption, ranges from 6 to 44%.

By comparison, in the present invention the PM emissions achieved using a FT fuel-in-water emulsion having FT fuel particle of substantially uniform size in the range 0.1 to 1.0 microns are from 53 to 91.5% lower than the Swedish Class I diesel.

Nothing in WO teaches, suggests or implies that the PM emissions could be lowered to this great an extent by using an emulsion wherein the hydrocarbon fuel particle size is substantially uniform and in the range of 0.1 to 1.0 microns as compared to employing an MACRO emulsion having particles of 10 microns and less.

The Macro emulsions of WO would have a particle size distribution over the entire 0.1 to 10 micron range. Nothing in WO teaches that superior PM emission reduction would or could be achieved using an emulsion wherein the fuel particles are substantially uniform and are in the 0.1 to 1.0 micron range. That superior results are unexpectedly obtained is apparent from a comparison of the data in WO with the results reported in the present application.

Based on WO, one would have expected fuel-in-water emulsions, regardless of fuel particle size, to generate substantially similar results within the ranges reported in WO. Nothing in WO can be seen as teaching, suggesting or implying a PM emissions reduction of between 53 to 91.5% compared to Swedish Class I Diesel, upon combustion of a FT fuel-in-water emulsion wherein the FT fuel particle size is substantially uniform in the range of 0.1 to 1.0 microns. Nothing teaches, suggests or implies that the level of PM emissions responds to the particle size of the emulsion and, therefore, nothing in the reference teaches, suggests, implies or motivates one skilled in the art to reduce the particle size of the emulsion to 0.1 to 1.0 microns in order to

achieve a reduction in PM emissions of between 53-91.5% compared to Swedish Class I diesel.

Support for new claims 13 and 14 can be found in original claim 3 and in the text at paragraph [0020] and for claims 15 and 16 in Example 2, paragraphs [0029] and [0030].

It is requested that the Examiner reconsider this case in light of the amendments made to the claims, and the above remarks, and that the rejections be withdrawn, the claims be allowed and the case passed to issue in due course.

Respectfully submitted,

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